■ENGINE CONTROL SYSTEM

1. General

The engine control system of the 1KR-FE engine has the following systems.

System	Outline
EFI (Electronic Fuel Injection)	● The D-type EFI system calculates the intake air volume based on the intake manifold pressure signal received from the vacuum sensor and the engine speed. ● An independent injection system in which fuel is injected into each cylinder once for each two revolution of the crankshaft is used. ● Fuel injection takes two forms: Synchronous injection, which always takes place with the same timing in accordance with the basic injection duration and an additional correction based on the signals provided by the sensors. Non-synchronous injection, which takes place at the time an injection request based on the signals provided by the sensors is detected, regardless of the crankshaft position.
ESA (Electronic Spark Advance)	● Ignition timing is determined by the engine ECU based on signals from various sensors. The engine ECU corrects ignition timing in response to engine knocking. ● This system selects the optimal ignition timing in accordance with the signals received from the sensors and sends the ignition signal (IGT) to the igniter.
ETCS-i (Electronic Throttle Control System-intelligent) [See page EG-44]	Optimally controls the throttle valve opening angle in accordance with the amount of accelerator pedal effort, the throttle valve opening control request from the engine ECU, and the condition of the engine and the vehicle.
VVT-i (Variable Valve Timing-intelligent) [See page EG-50]	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.
Air Conditioner Cut-off Control*	By turning the air conditioner compressor ON or OFF in accordance with the engine condition, drivability is maintained.
Cooling Fan Control [See page EG-54]	Cooling fan operation is controlled by signals from the engine ECU based on the water temperature sensor signal.
Fuel Pump Control [See page EG-55]	Fuel pump operation is controlled by signals from the engine ECU. A fuel cut control is used to stop the fuel pump when the SRS airbags are deployed during front or side collision.
Heated Oxygen Sensor Heater Control	Maintains the temperature of the heated oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.
Evaporative Emission Control	The engine ECU controls the purge flow of evaporative emission (HC) in the charcoal canister in accordance with engine conditions.
Starter Control (Cranking Hold Function) [See page EG-56]	● On the models without smart entry & start system, once the ignition switch is turned to the START position, this control continues to operate the starter until the engine is started. ● On the models with smart entry & start system, once the engine switch is pushed, this control continues to operate the starter until the engine is started.

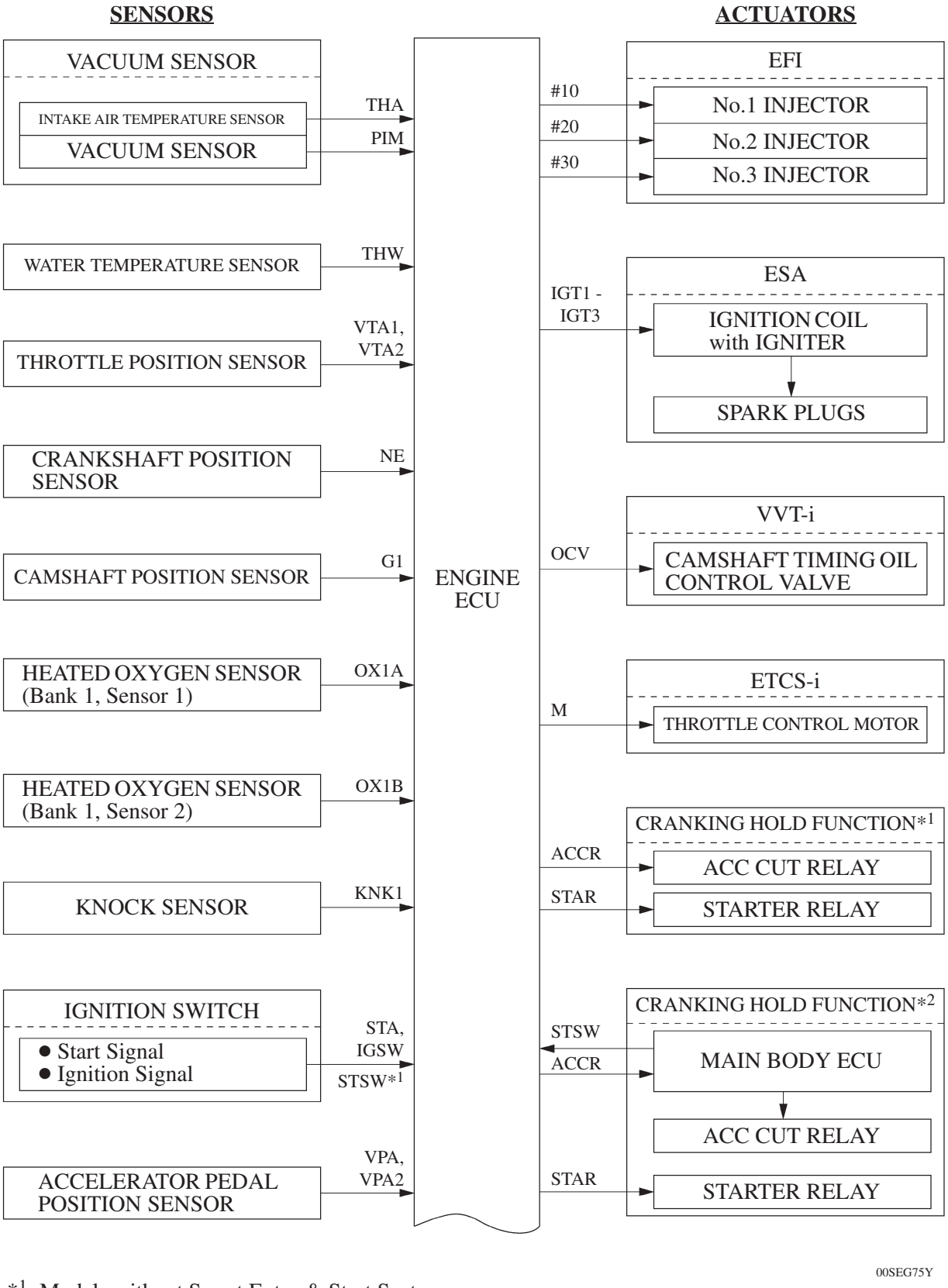
*: Models with Air Conditioner

(Continued)

System	Outline
Engine Immobilizer	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid key.
Diagnosis [See page EG-60]	When the engine ECU detects a malfunction, the engine ECU diagnoses and memorizes the failed section.
Fail-safe [See page EG-60]	When the engine ECU detects a malfunction, the engine ECU stops or controls the engine according to the data already stored in the memory.

2. Construction

The configuration of the engine control system in the 1KR-FE engine is as shown in the following chart.

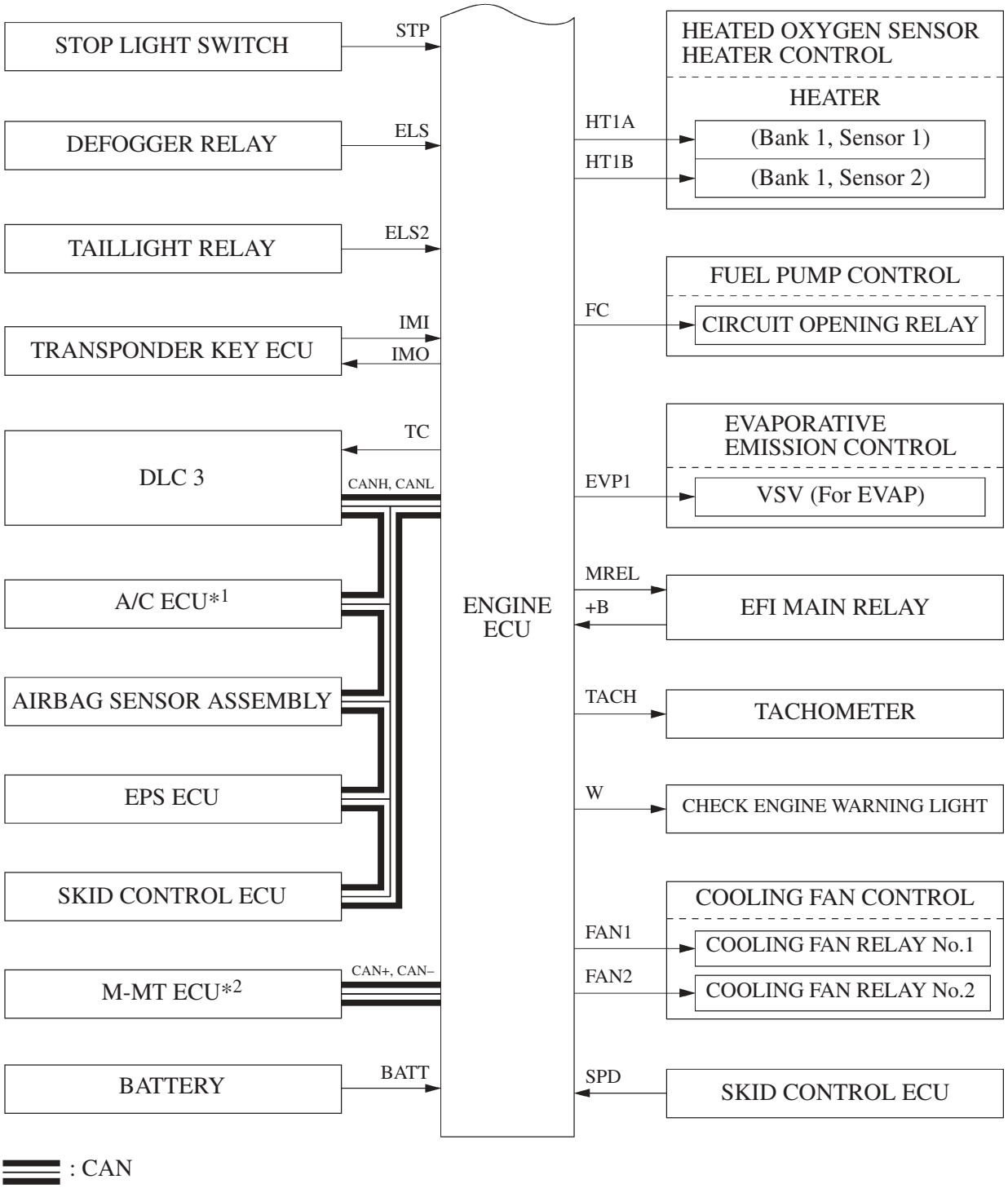


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*1: Models without Smart Entry & Start System

*2: Models with Smart Entry & Start System

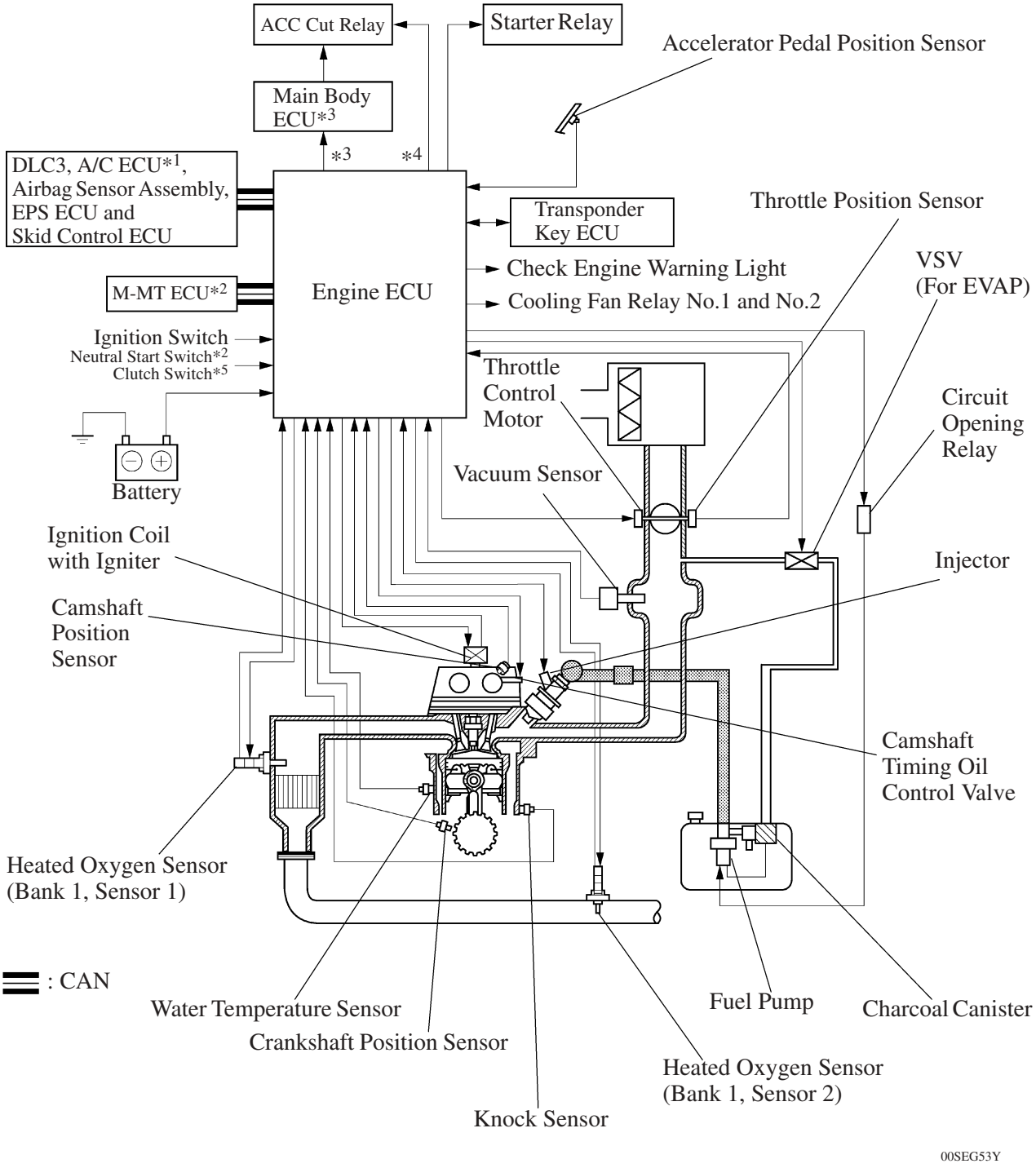
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*1: Models with Air Conditioner
*2: Only for Multi-mode Manual Transmission Models

3. Engine Control System Diagram

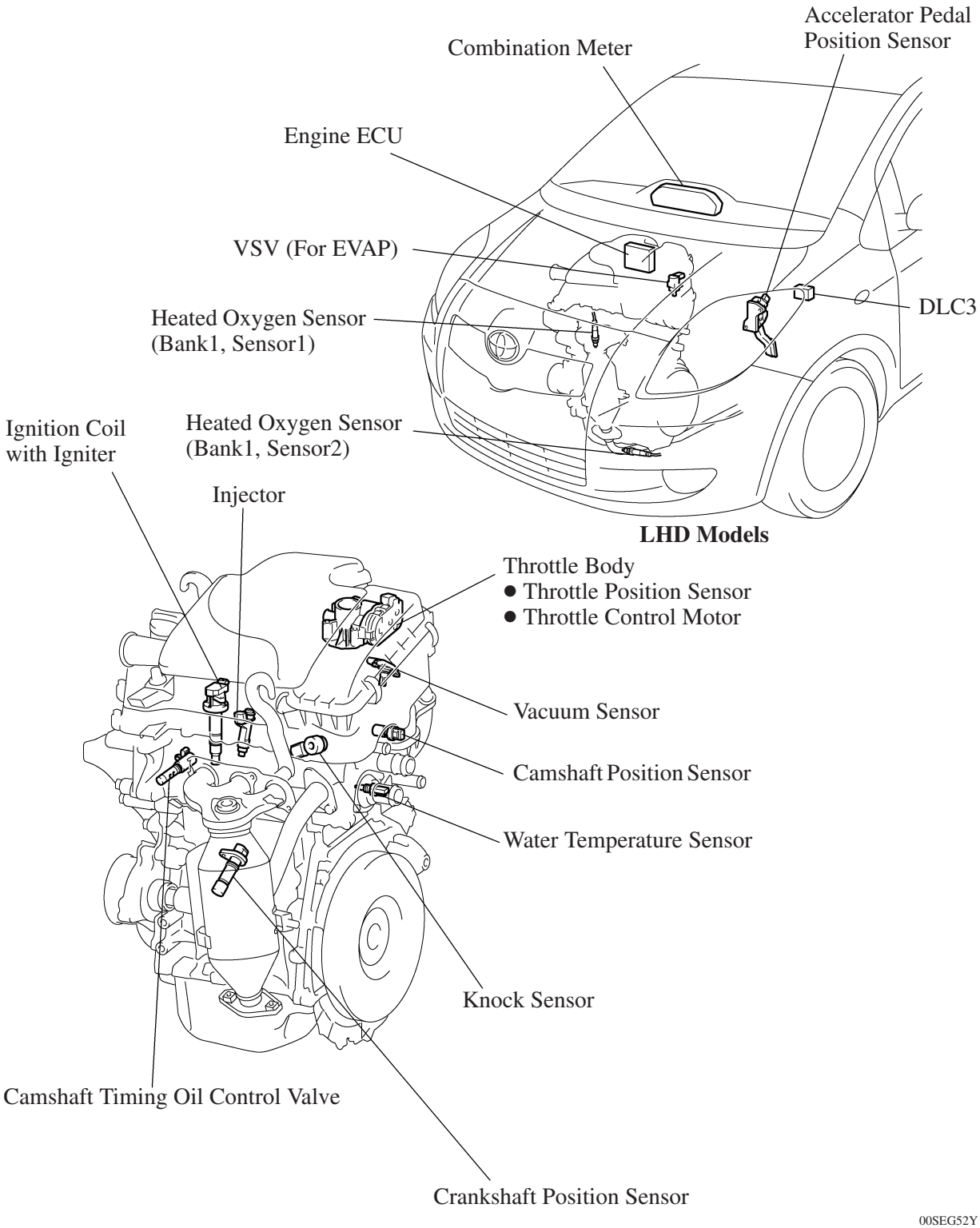


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*1: Models with Air Conditioner
*2: Multi-mode Manual Transmission Models
*3: Models with Smart Entry & Start System
*4: Models without Smart Entry & Start System
*5: M/T Models

EG

4. Layout of Main Components



5. Main Components of Engine Control System

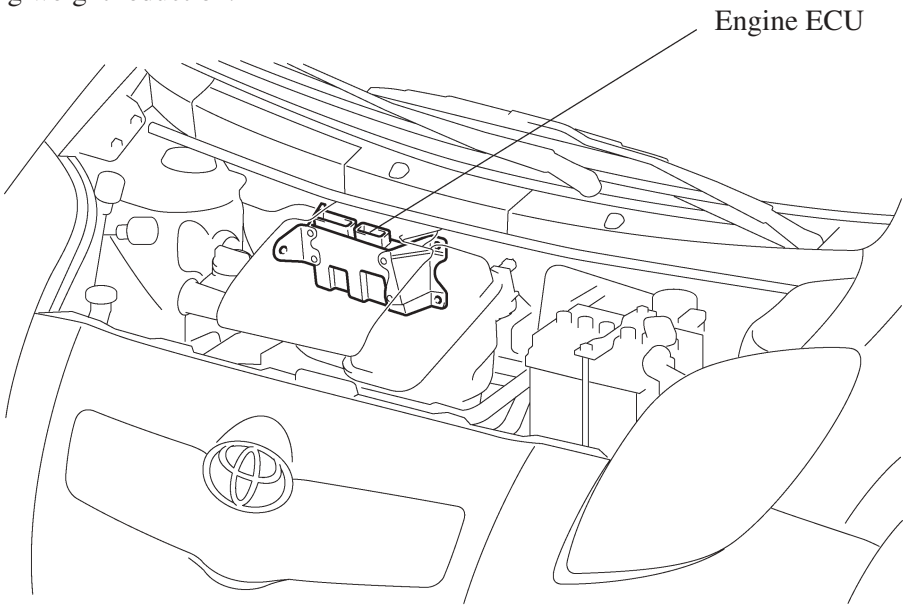
General

The main components of the 1KR-FE engine control system are as follows:

Component	Outline	Quantity	Function
Engine ECU	16-bit CPU BOSCH	1	The engine ECU optimally controls the EFI, ESA, and ETCS-i to suit the operating conditions of the engine in accordance with the signals provided by the sensors.
Heated Oxygen Sensor	Planar Type with Heater/BOSCH	2	This sensor detects the oxygen concentration in the exhaust emission by measuring the electromotive force which is generated in the sensor itself.
Vacuum Sensor	Semiconductor Silicon Chip Type	1	This sensor uses built-in semiconductors to detect the intake manifold pressure.
Intake Air Temperature Sensor	Thermistor Type	1	● This sensor is built into the vacuum sensor. ● This sensor detects the intake air temperature by means of an internal thermistor.
Crankshaft Position Sensor (Rotor Teeth)	Pickup Coil Type (36-2)	1	This sensor detects the engine speed and performs the cylinder identification.
Camshaft Position Sensor (Rotor Teeth)	Hall Type (3) BOSCH	1	This sensor performs the cylinder identification.
Water Temperature Sensor	Thermistor Type	1	This sensor detects the water temperature by means of an internal thermistor.
Knock Sensor	Non-resonant Flat Type/BOSCH	1	This sensor detects an occurrence of the engine knocking indirectly from the vibration of the cylinder block caused by the occurrence of engine knocking.
Accelerator Pedal Position Sensor	Non-contact Type	1	This sensor detects the amount of pedal effort applied to the accelerator pedal.
Throttle Position Sensor	Non-contact Type	1	This sensor detects the throttle valve opening angle.
Injector	4-hole Type	3	The injector is an electromagnetically-operated nozzle which injects fuel in accordance with the signals from the engine ECU.

Engine ECU

The engine ECU is installed in the engine compartment. As a result, the wiring harness has been shortened, thus realizing weight reduction.

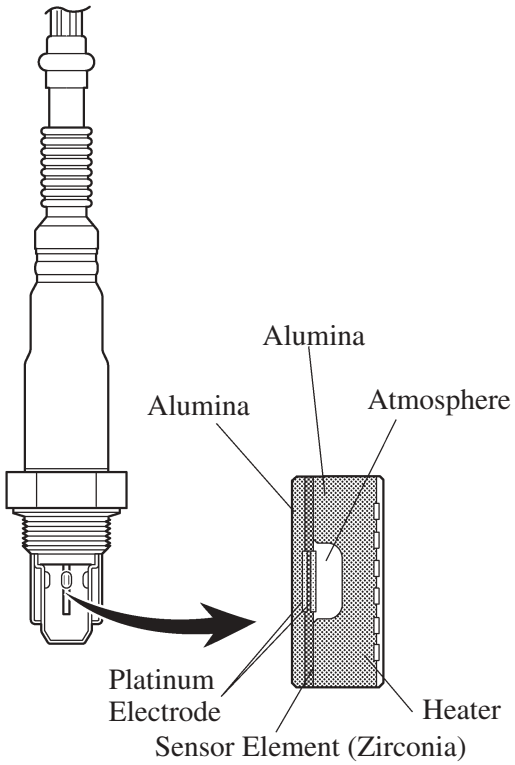


LHD Models

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Heated Oxygen Sensor

- A planar type heated oxygen sensor made by Bosch is used.
- Compared to the conventional type (cup type), the sensor and heater portions of the planar type are narrower overall. Because the heat of the heater acts directly on the alumina and zirconia (of the sensor portion), it accelerates the activation of the sensor.

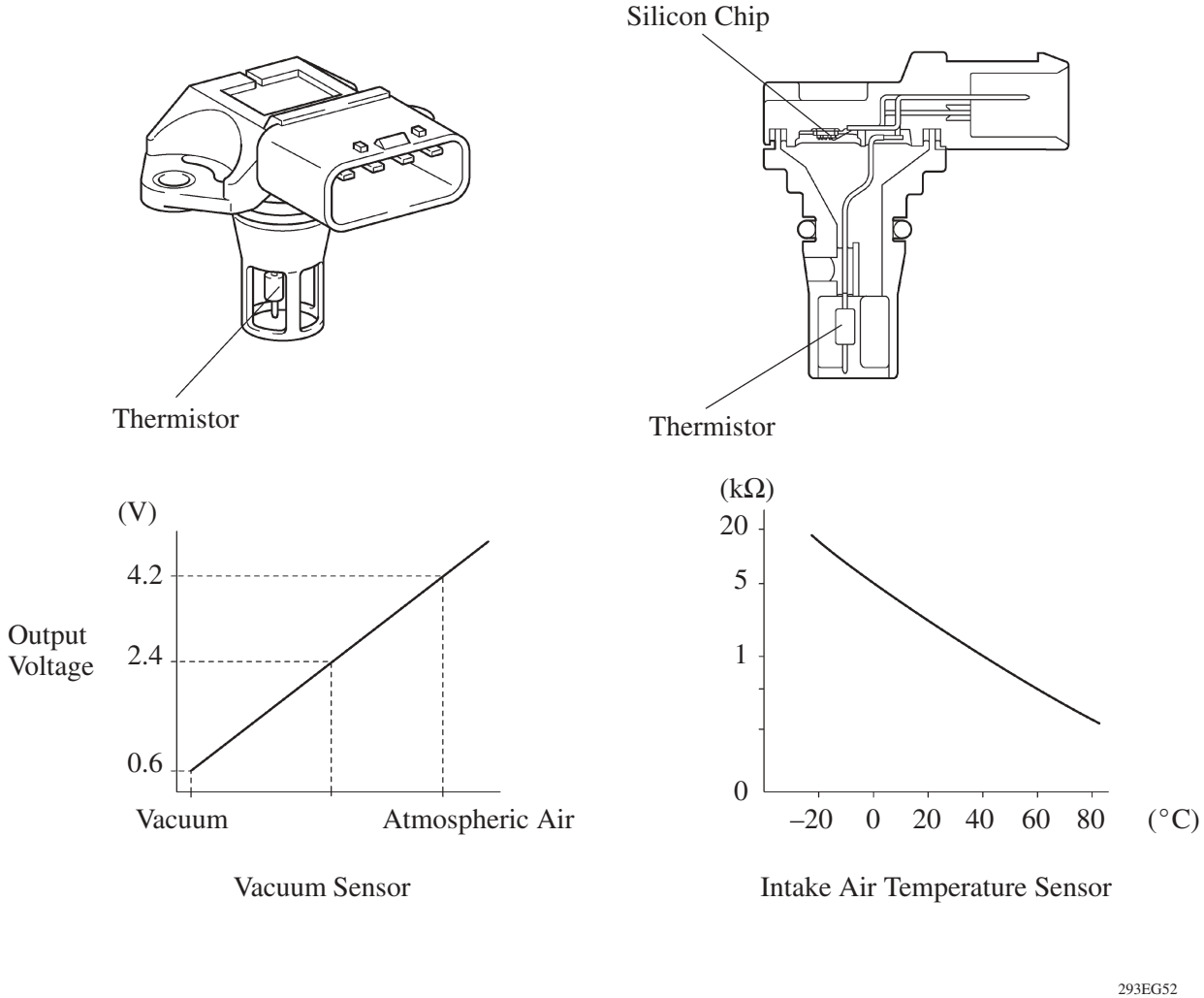


Planar Type Heated Oxygen Sensor / BOSCH

287EG66

Vacuum Sensor

- The vacuum sensor has a built-in intake air temperature sensor.
- The vacuum sensor consists of a silicon chip which utilizes the characteristic of a silicon chip that changes its electrical resistance when pressure is applied to it. The sensor converts the pressure into an electrical signal, and sends it to the engine ECU in an amplified form.
- The intake air temperature sensor detects the intake air temperature in the intake manifold via a thermistor.



Vacuum Sensor

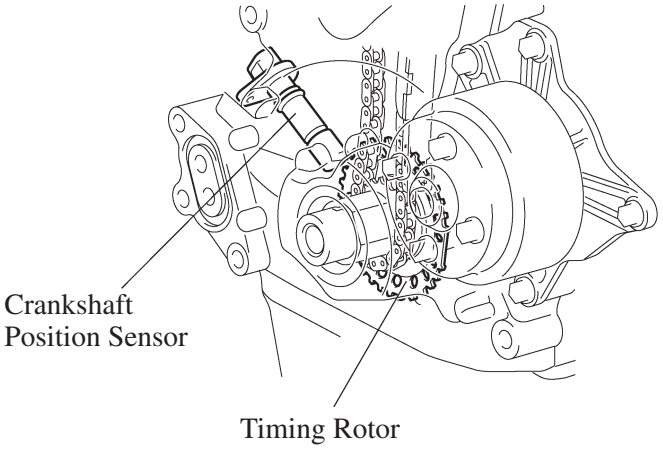
Intake Air Temperature Sensor

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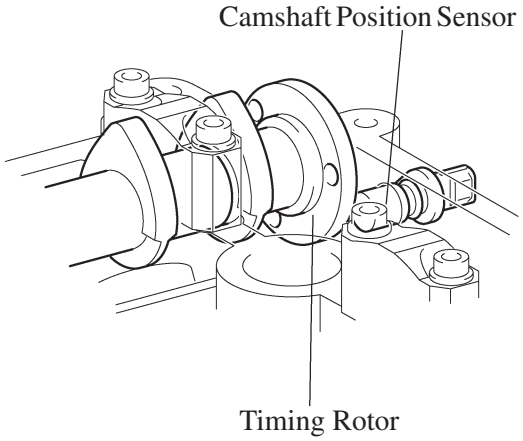
Crankshaft and Camshaft Position Sensors

1) General

- Pickup coil type crankshaft position sensor is used. The timing rotor of the crankshaft consists of 34 teeth, with 2 teeth missing. The crankshaft position sensor outputs the crankshaft rotation signals every 10°, and the missing teeth are used to determine the top-dead-center.
- Hall type camshaft position sensor is used. To detect the camshaft position, a timing rotor on the intake camshaft is used to generate 3 (3 Hi Output, 3 Lo Output) pulses for every 2 revolutions of the crankshaft.

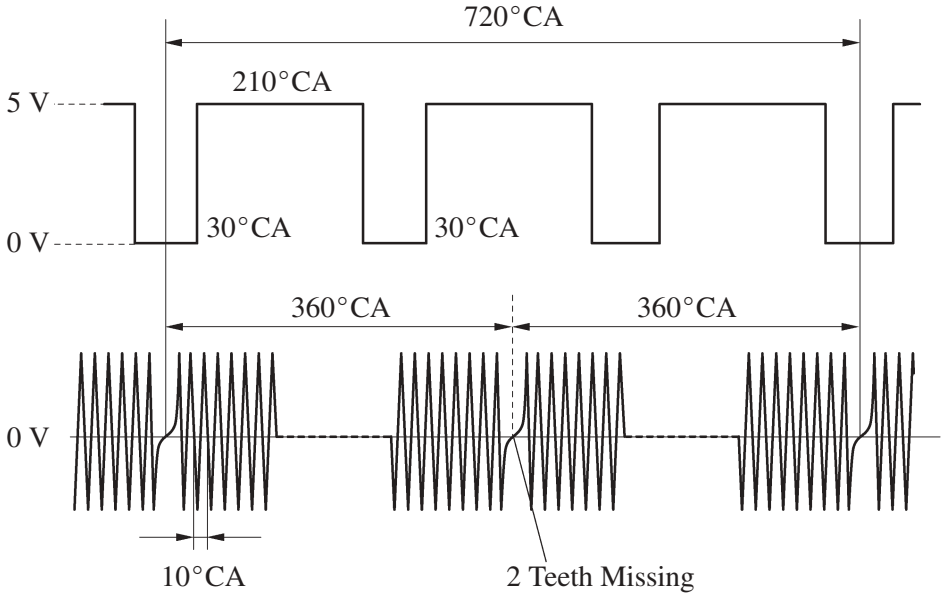


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▶ Sensor Output Waveforms ◀



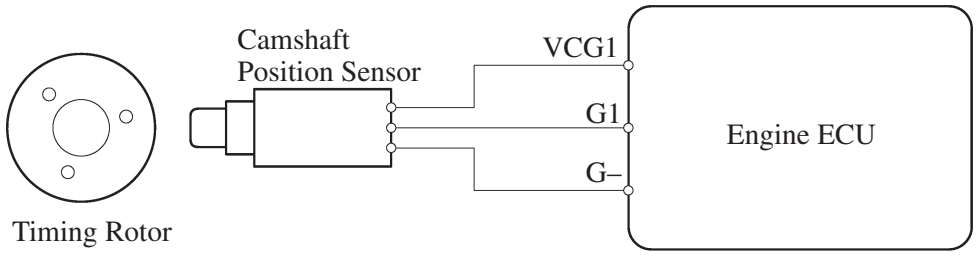
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2) Hall Type Camshaft Position Sensor

- The Hall type camshaft position sensor consists of magnet and Hall IC. The distance between the pin on the timing rotor and the camshaft position sensor changes with the rotational movement of the timing rotor. As a result, the magnetic flux of the magnet inside the camshaft position sensor changes. The Hall IC transmits this change to the engine ECU in the form of output voltage. The engine ECU detects the camshaft position based on this output voltage.
- The differences between the Hall type camshaft position sensor and the pickup coil type camshaft position sensor used on the conventional model are as follows.

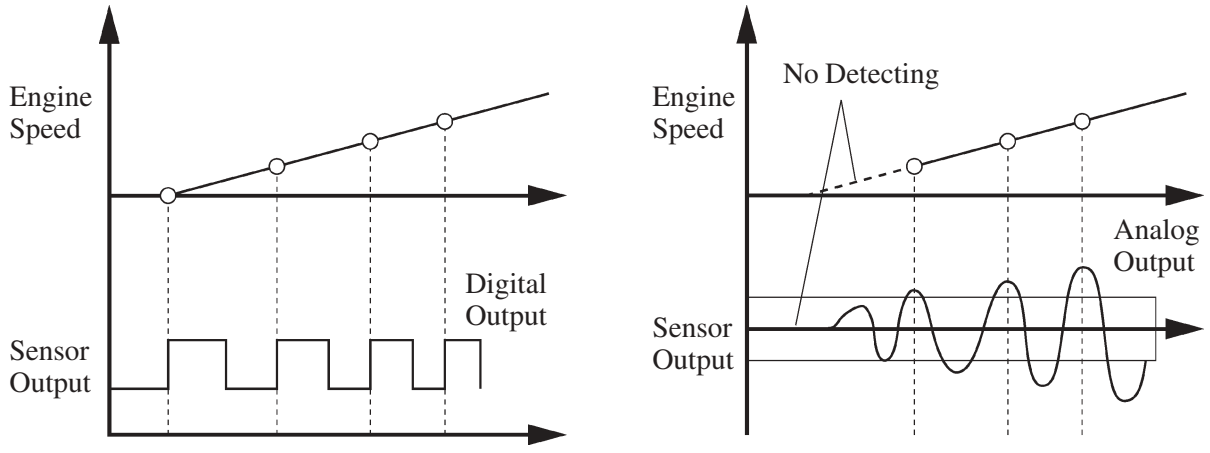
Item	Sensor Type	
	Hall	Pickup Coil
Signal Output	Constant digital output starts from low engine speeds	Analog output changes with the engine speed
Camshaft Position Detection	Detection based on the waveforms output throughout the timing rotor speed range	Detection based on the waveform output as the protruded portion of the timing rotor passes

▶ Wiring Diagram ◀



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▶ Hall Type and Pickup Coil Type Output Waveform Image Comparison ◀



Hall Type **Pickup Coil Type**

232CH41

Knock Sensor (Flat Type)

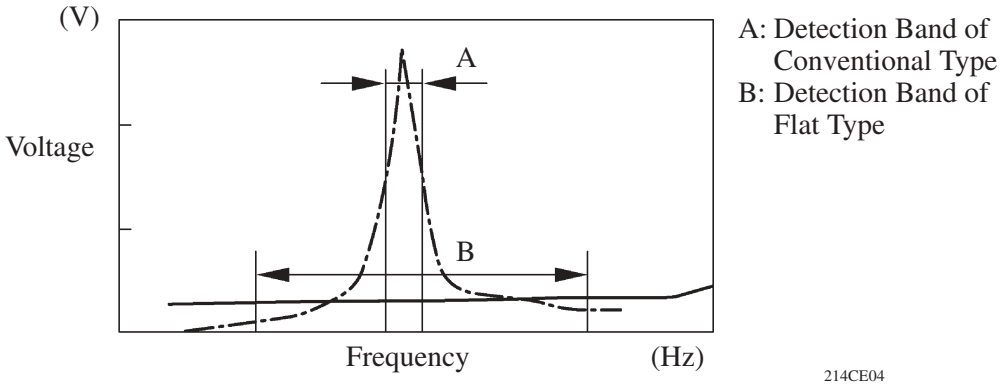
1) General

In the conventional type knock sensor (resonant type), a vibration plate which has the same resonance point as the knocking frequency of the engine is built in and can detect the vibration in this frequency band.
On the other hand, a flat type knock sensor (non-resonant type) has the ability to detect vibration in a wider frequency band from about 6 kHz to 15 kHz, and has the following features.

- The engine knocking frequency will change a bit depending on the engine speed. The flat type knock sensor can detect the vibration even when the engine knocking frequency is changed. Thus the vibration detection ability is increased compared to the conventional type knock sensor, and a precise ignition timing control is possible.

—·— : Resonance Characteristic of Conventional Type

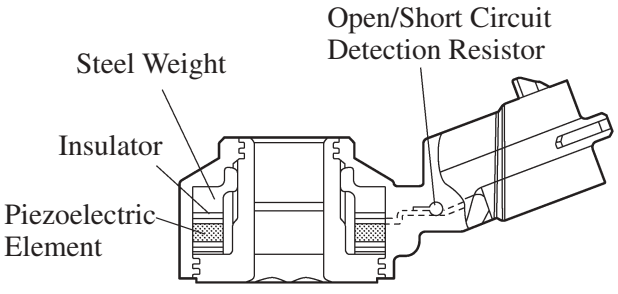
——— : Resonance Characteristic of Flat Type



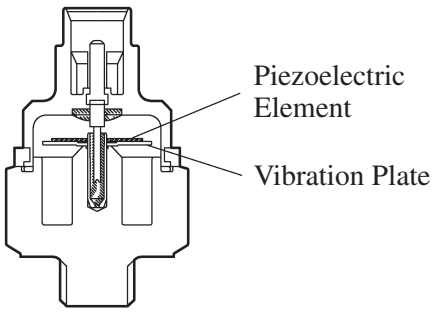
Characteristic of Knock Sensor

2) Construction

- The flat type knock sensor is installed on the engine through the stud bolt installed on the cylinder block. For this reason, a hole for the stud bolt is running through in the center of the sensor.
- Inside of the sensor, a steel weight is located on the upper portion and a piezoelectric element is located under the weight through the insulator.



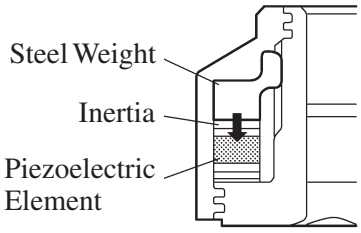
Flat Type Knock Sensor / BOSCH (Non-resonant Type)



Conventional Type Knock Sensor (Resonant Type)

3) Operation

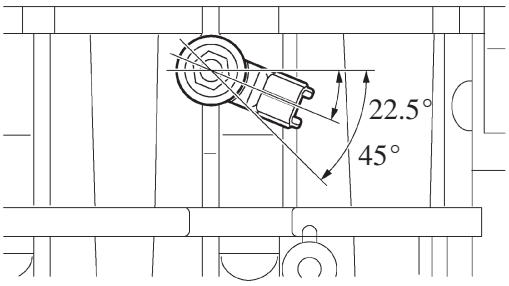
The knocking vibration is transmitted to the steel weight and its inertia applies pressure to the piezoelectric element. The action generates electromotive force.



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Service Tip

- In accordance with the adoption of an open/short circuit detection resistor, the inspection method for the sensor has been changed. For details, refer to the Yaris Repair Manual (Pub. No. RM00S1E).
- To prevent the water accumulation in the connecter, make sure to install the flat type knock sensor in the position as shown in the following illustration.

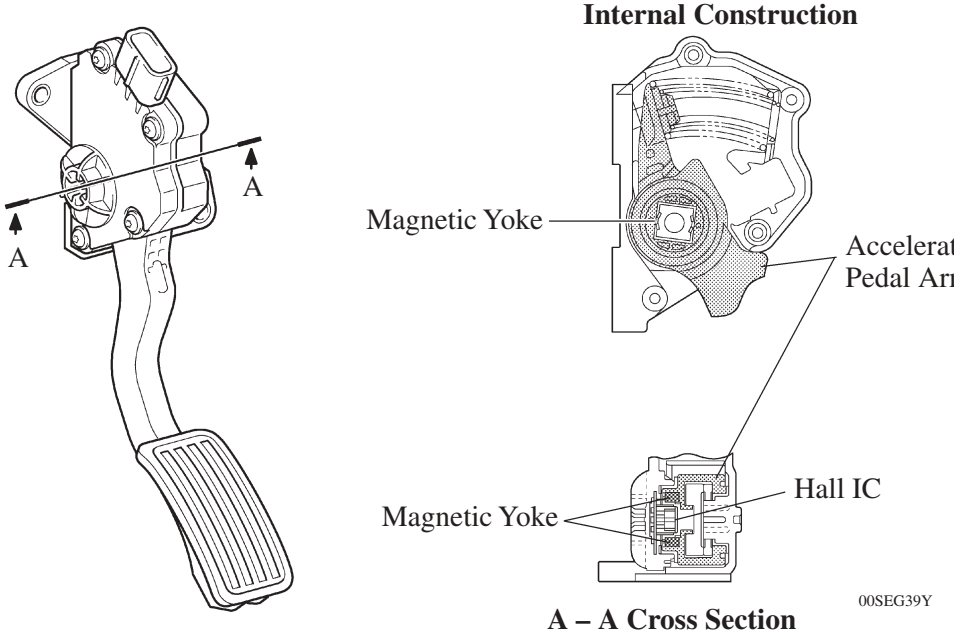


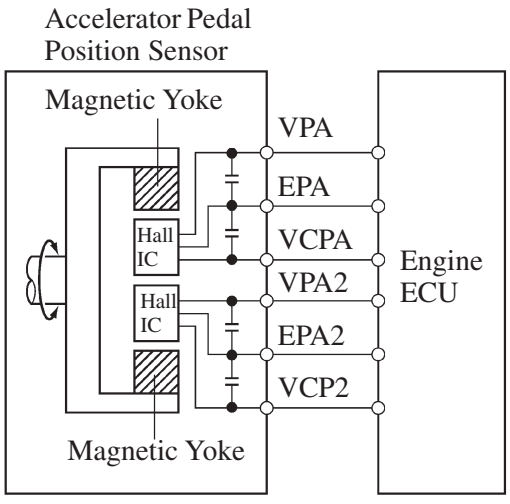
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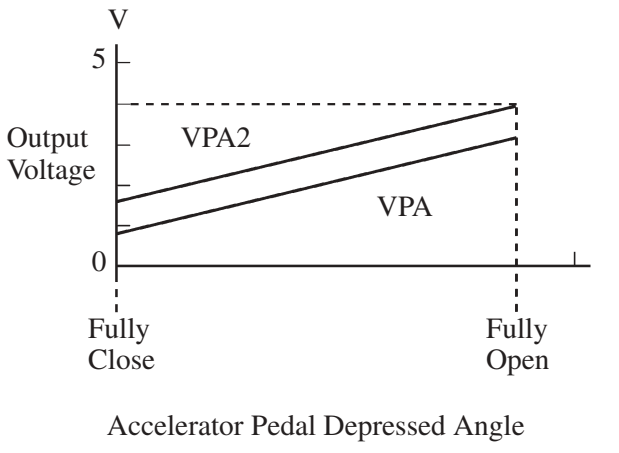
Accelerator Pedal Position Sensor

The non-contact type accelerator pedal position sensor uses a Hall IC.

- The magnetic yoke that is mounted at the accelerator pedal arm rotates around the Hall IC in accordance with the amount of effort that is applied to the accelerator pedal. The Hall IC converts the changes in the magnetic flux that occur at that time into electrical signals, and outputs them as accelerator pedal effort to the engine ECU.
- The Hall IC contains circuits for the main and sub signals. It converts the accelerator pedal depressed angles into electric signals with two differing characteristics and outputs them to the engine ECU.





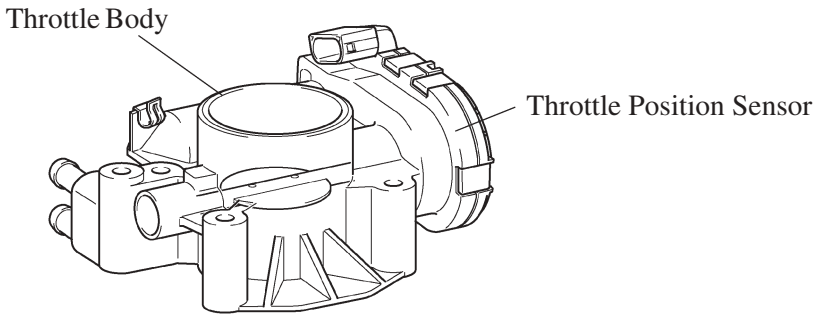


Service Tip

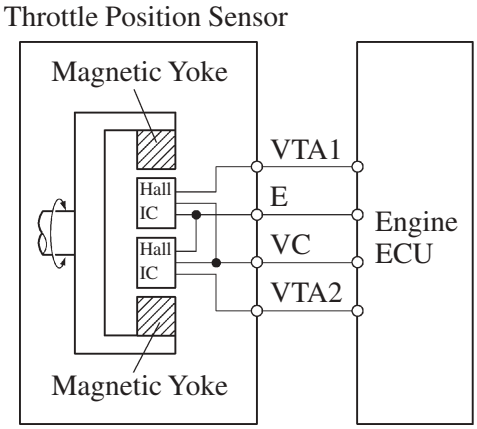
The inspection method differs from the conventional contact type accelerator pedal position sensor because this non-contact type sensor uses a Hall IC.
For details, refer to the Yaris Repair Manual (Pub. No. RM00S1E).

Throttle Position Sensor

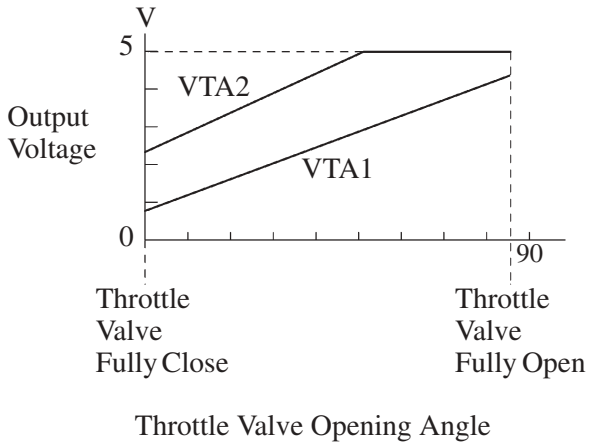
The throttle position sensor is mounted on the throttle body to detect the opening angle of the throttle valve. The throttle position sensor converts the magnetic flux density that changes when the magnetic yoke (located on the same axis as the throttle shaft) rotates around the Hall IC into electric signals to operate the throttle control motor.



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Service Tip

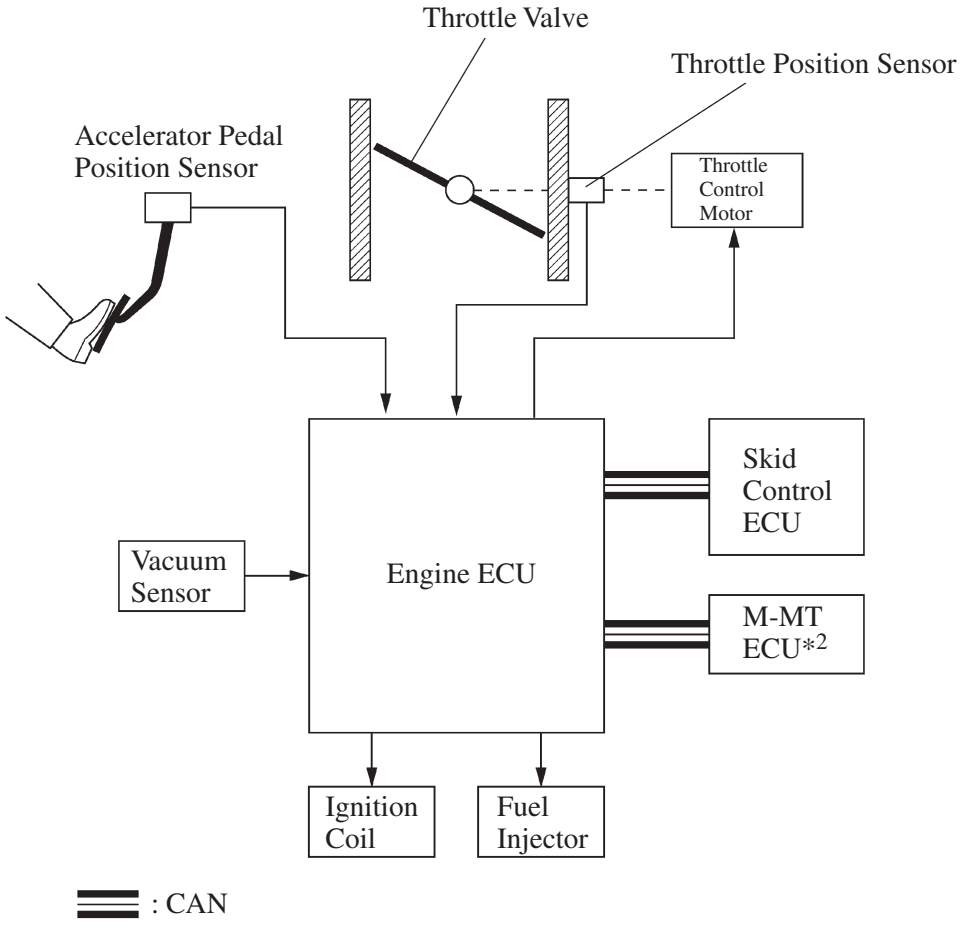
The inspection method differs from the conventional contact type throttle position sensor because this non-contact type sensor uses a Hall IC.
For details, refer to the Yaris Repair Manual (Pub. No. RM00S1E).

6. ETCS-i (Electronic Throttle Control System-intelligent)

General

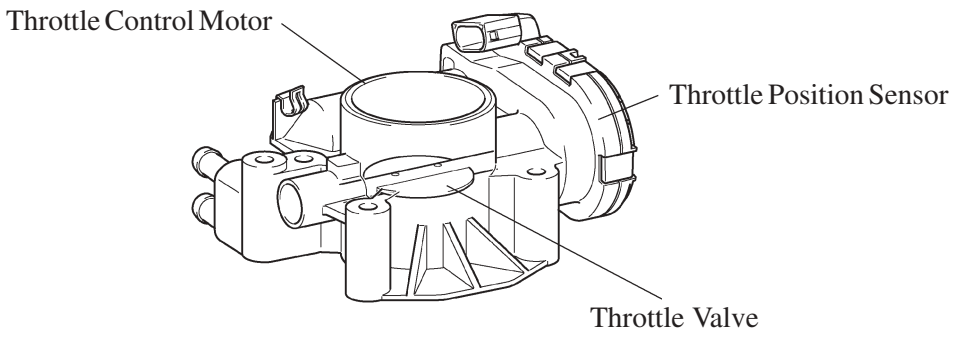
- The ETCS-i is used, providing excellent throttle control in all the operating ranges.
  The accelerator cable has been discontinued, and an accelerator pedal position sensor has been provided on the accelerator pedal.
- In the conventional throttle body, the throttle valve opening angle is determined invariably by the amount of the accelerator pedal effort. In contrast, the ETCS-i uses the engine ECU to calculate the optimal throttle valve opening angle that is appropriate for the respective driving condition and uses a throttle control motor to control the opening angle.
- The ETCS-i controls the ISC (Idle Speed Control), TRC*1 (Traction Control), and VSC*1 (Vehicle Stability Control) systems.
- In case of an abnormal condition, this system switches to the limp mode.
- On the M-MT (Multi-mode Manual Transmission) models, the engine ECU and the M-MT ECU maintain communication via the CAN (Controller Area Network). Thus, the engine ECU is able to effect ETCS-i control to suit the M-MT system control in order to optimize the system control of the M-MT ECU.

▶ System Diagram ◀



*1: Optional Equipment
*2: Multi-mode Manual Transmission Models Only

Construction



293EG01

1) Throttle Position Sensor

The throttle position sensor is mounted on the throttle body to detect the opening angle of the throttle valve.

2) Throttle Control Motor

A DC motor with excellent response and minimal power consumption is used for the throttle control motor. The engine ECU performs the duty ratio control of the direction and the amperage of the current that flows to the throttle control motor in order to regulate the opening angle of the throttle valve.

Operation

1) General

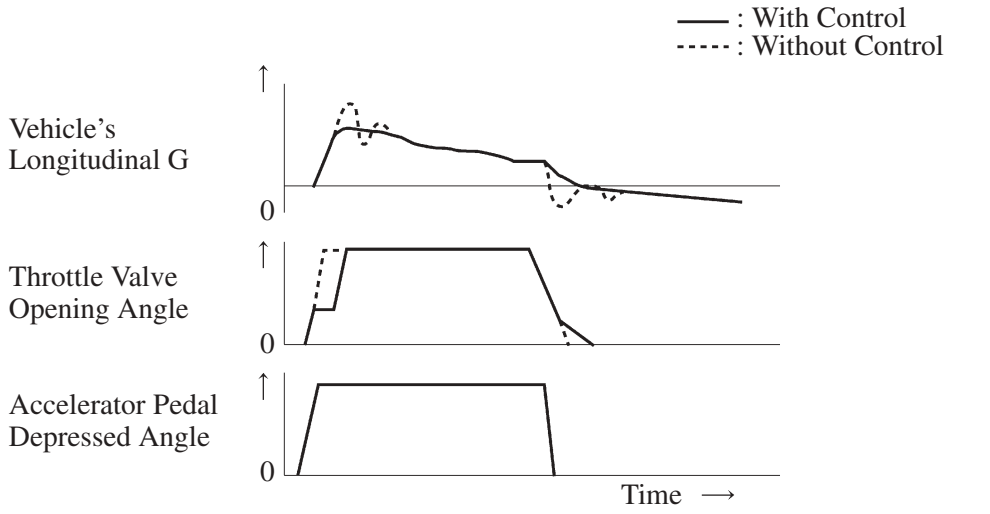
The engine ECU drives the throttle control motor by determining the target throttle valve opening angle in accordance with the respective operating condition.

- Non-linear Control
- Idle Speed Control
- TRC Throttle Control*1
- VSC Coordination Control*1
- M-MT System Control*2

2) Non-linear Control

The engine ECU controls the throttle valve to an optimal opening angle that is appropriate for the driving condition such as the amount of the accelerator pedal effort and the engine speed in order to realize excellent throttle control and comfort in all operating ranges.

▶ Control Examples During Acceleration and Deceleration ◀



005EG13Y

3) Idle Speed Control

The engine ECU controls the throttle valve in order to constantly maintain an ideal idle speed.

4) TRC Throttle Control*1

As part of TRC system, the throttle valve is closed by a request signal from the skid control ECU if an excessive amount of slippage is created at a driving wheel, thus it facilitates the vehicle in ensuring stability and driving force.

*1: Models with VSC and TRC Systems
*2: M-MT Models

5) VSC Coordination Control*1

In order to bring the effectiveness of the VSC system control into full play, the throttle valve opening angle is controlled by effecting a coordination control with the skid control ECU.

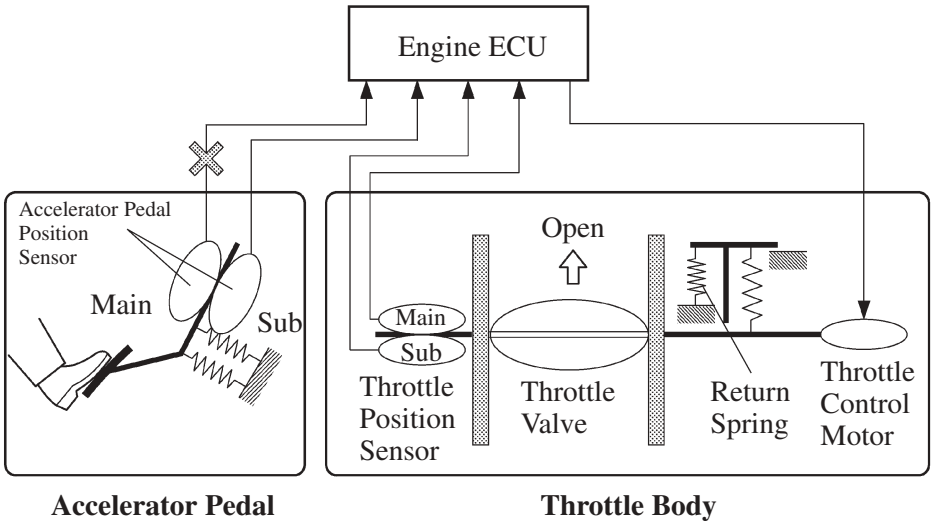
6) M-MT System Control*2

As part of the M-MT system, the throttle valve opening angle is controlled by a request signal from the M-MT ECU.

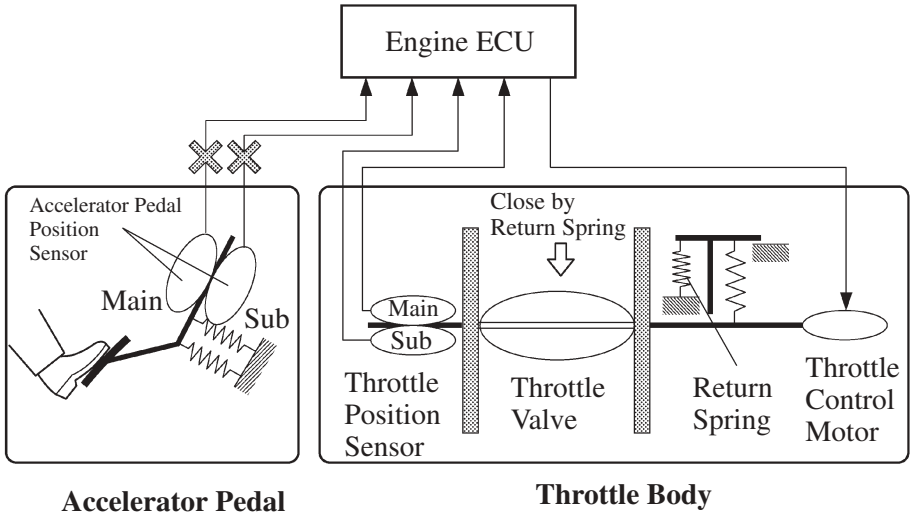
*1: Models with VSC and TRC Systems
*2: M-MT Models

Fail-safe of Accelerator Pedal Position Sensor

- The accelerator pedal position sensor is comprised of two (main, sub) sensor circuits. If a malfunction occurs in either one of the sensor circuits, the engine ECU detects the abnormal signal by voltage difference between these two sensor circuits and switches to the limp mode. In the limp mode, the remaining circuit is used to calculate the accelerator pedal depressed angle, in order to operate the vehicle under limp mode control.

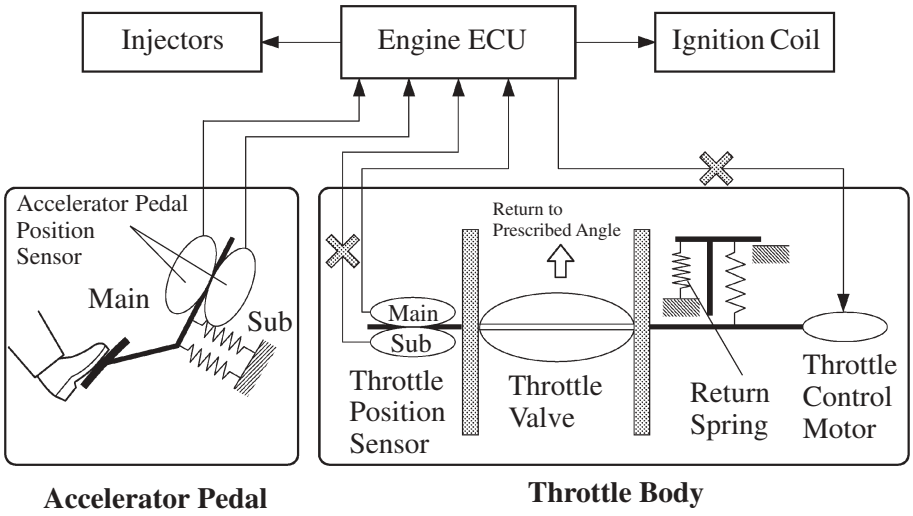


- If both circuits have a malfunction, the engine ECU detects the abnormal signal by voltage from these two sensor circuits and discontinues the throttle control. At this time, the vehicle can be driven within its idling range.



Fail-safe of Throttle Position Sensor

- The throttle position sensor is comprised of two (main, sub) sensor circuits. If a malfunction occurs in either one or both of the sensor circuits, the engine ECU detects the abnormal signal by voltage difference between these two sensor circuits, cuts off the current to the throttle control motor, and switches to the limp mode. Then, the force of the return spring causes the throttle valve to return and stay at the prescribed opening angle. At this time, the vehicle can be driven in the limp mode while the engine output is regulated through the control of the fuel injection (intermittent fuel-cut) and ignition timing in accordance with the accelerator opening.
- The same control as above is effected if the engine ECU detects a malfunction in the throttle control motor system.

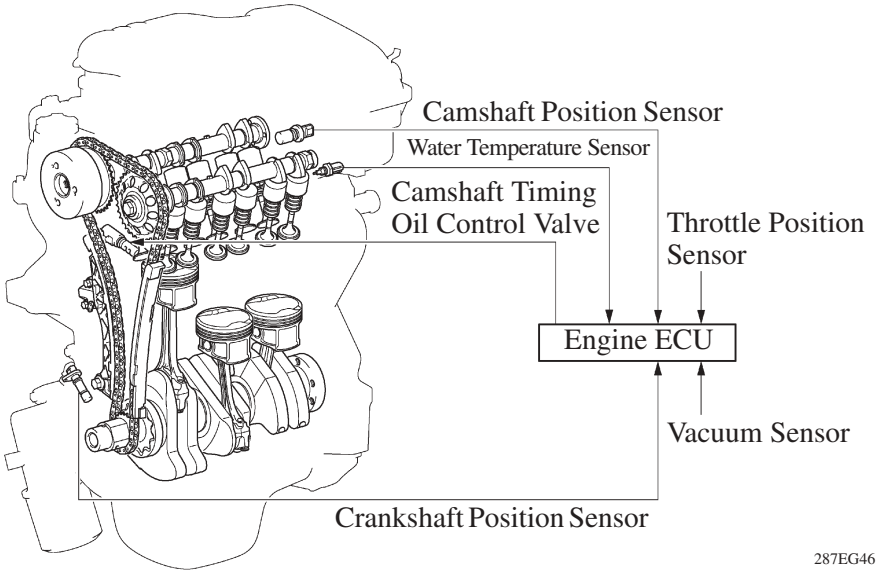


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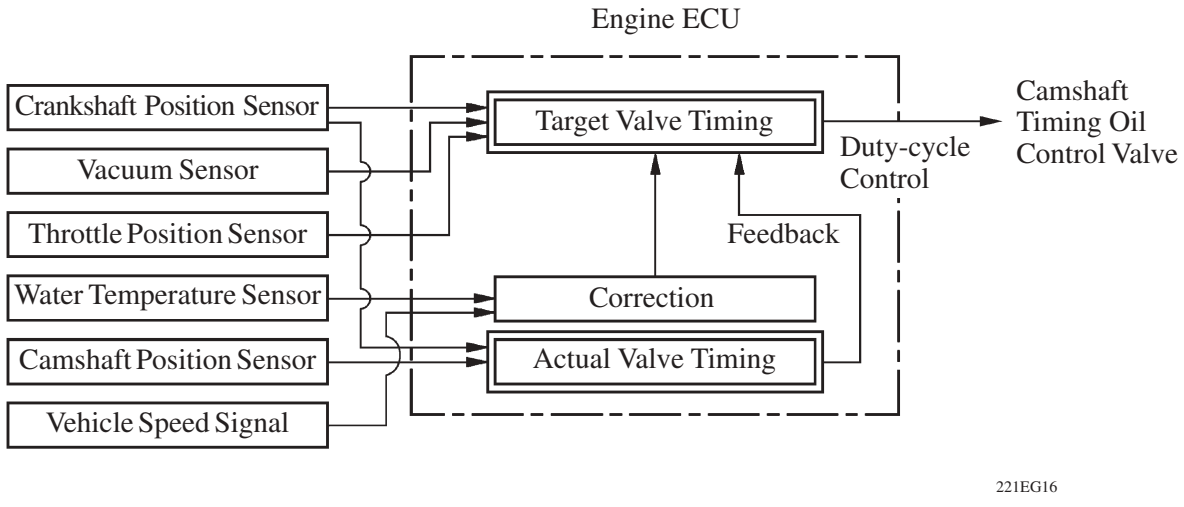
7. VVT-i (Variable Valve Timing-intelligent) System

General

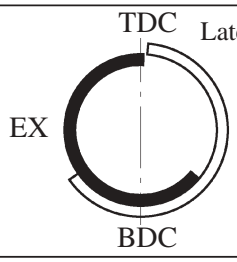
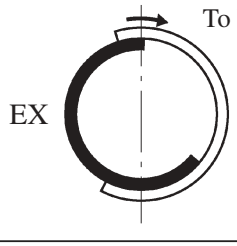
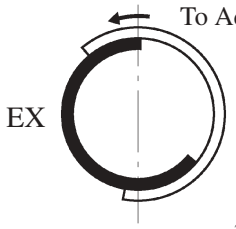
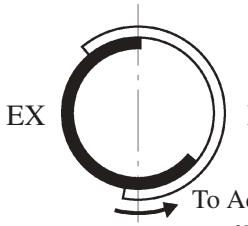
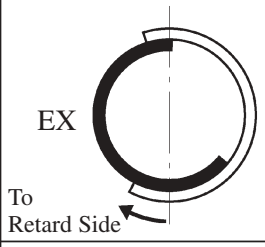
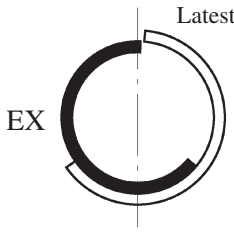
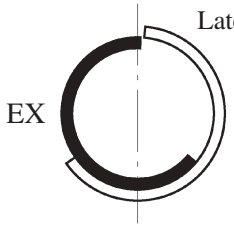
- The VVT-i system is designed to control the intake camshaft within a range of 45° (of Crankshaft Angle) to provide valve timing that is optimally suited to the engine condition. This improves torque in all the speed ranges as well as increasing fuel economy, and reducing exhaust emissions.



- Using the engine speed signal, vehicle speed signal, and the signals from vacuum sensor, throttle position sensor and water temperature sensor, the engine ECU can calculate optimal valve timing for each driving condition and controls the camshaft timing oil control valve. In addition, the engine ECU uses signals from the camshaft position sensor and the crankshaft position sensor to detect the actual valve timing, thus providing feedback control to achieve the target valve timing.



Effectiveness of the VVT-i System

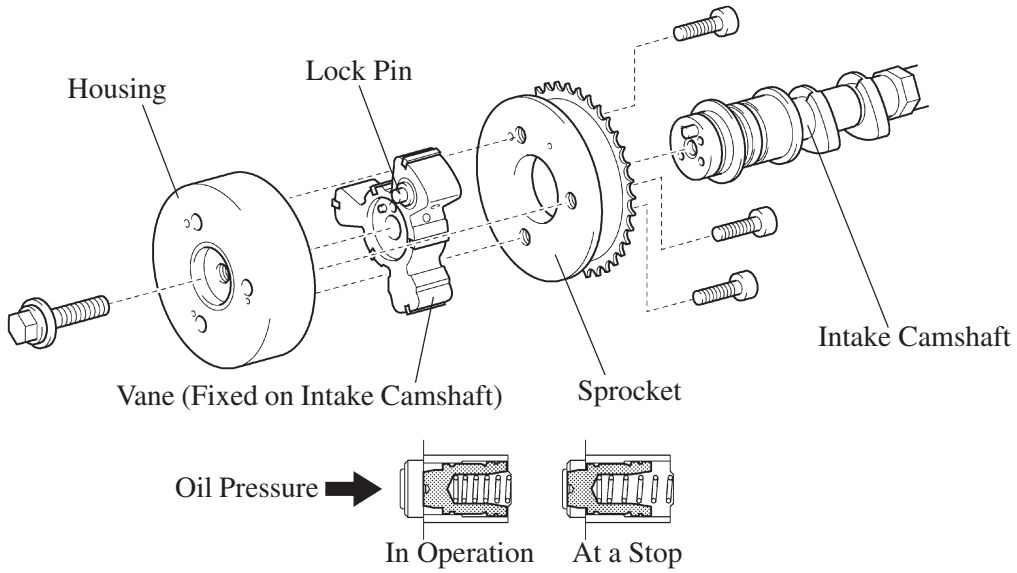
Operation State	Objective	Effect
During Idling	 Decreasing overlap to reduce blow back to the intake side.	● Stabilized idling rpm ● Better fuel economy
At Light Load	 Decreasing overlap to reduce blow back to the intake side.	Ensured engine stability
At Medium Load	 Increasing overlap to increase internal EGR to reduce pumping loss.	● Better fuel economy ● Improved emission control
In Low to Medium Speed Range with Heavy Load	 Advancing the intake valve close timing for volumetric efficiency improvement.	Improved torque in low to medium speed range
In High Speed Range with Heavy Load	 Retarding the intake valve close timing for volumetric efficiency improvement.	Improved output
At Low Temperatures	 Eliminating overlap to reduce blow back to the intake side leads to the lean burning condition, and stabilizes the idling speed at fast idle.	● Stabilized fast idle rpm ● Better fuel economy
● Upon Starting ● Stopping the Engine	 Eliminating overlap to reduce blow back to the intake side.	Improved startability

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Construction

1) VVT-i Controller

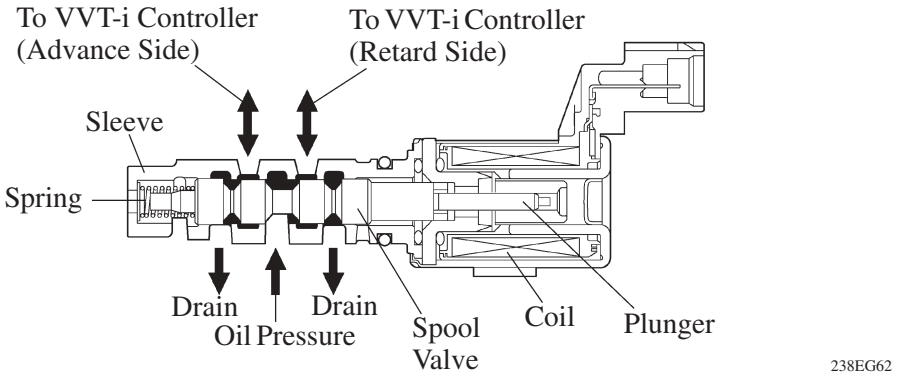
This controller consists of the housing driven from the timing chain and the vane coupled with the intake camshaft. The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously. When the engine is stopped, the intake camshaft will be in the most retarded state to ensure startability. When hydraulic pressure is not applied to the VVT-i controller immediately after the engine has started, the lock pin locks the movement of the VVT-i controller to prevent a knocking noise. Thereafter, when hydraulic pressure is applied to the VVT-i controller, the lock pin is released.



Lock Pin

2) Camshaft Timing Oil Control Valve

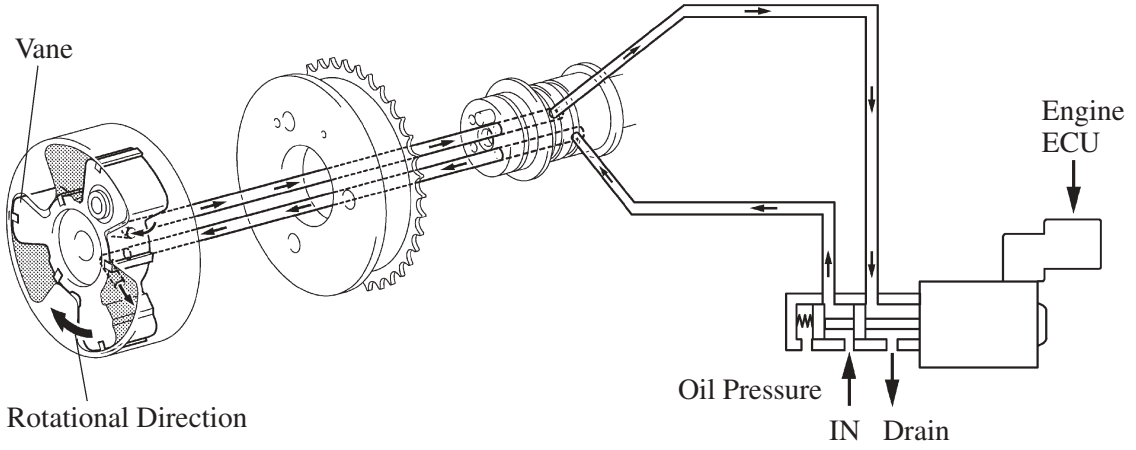
This camshaft timing oil control valve controls the spool valve using duty-cycle control from the engine ECU. This allows hydraulic pressure to be applied to the VVT-i controller advance or retard side. When the engine is stopped, the camshaft timing oil control valve is in the most retarded position.



Operation

1) Advance

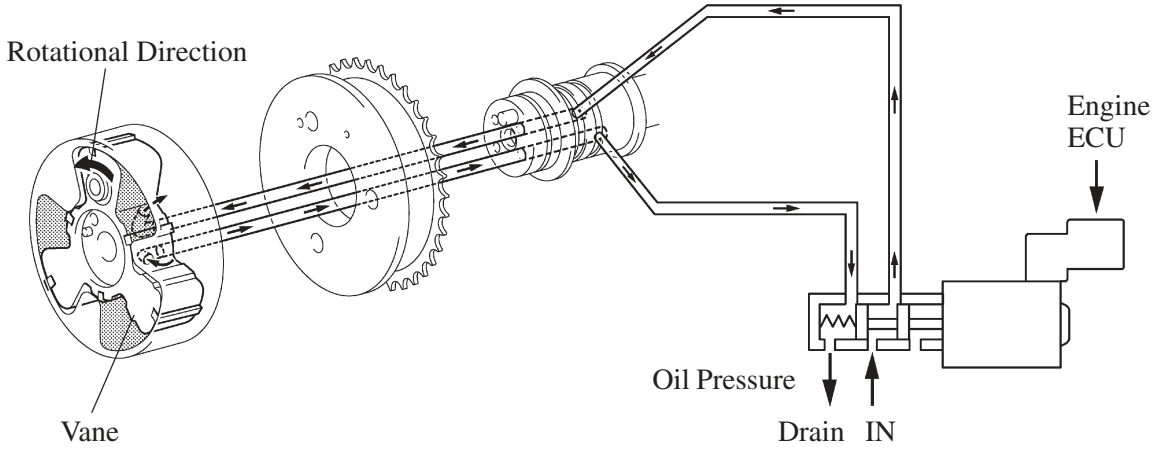
When the camshaft timing oil control valve is operated as illustrated below by the advance signal from the engine ECU, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



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2) Retard

When the camshaft timing oil control valve is operated as illustrated below by the retard signal from the engine ECU, the resultant oil pressure is applied to the timing retard side vane chamber to rotate the camshaft in the timing retard direction.



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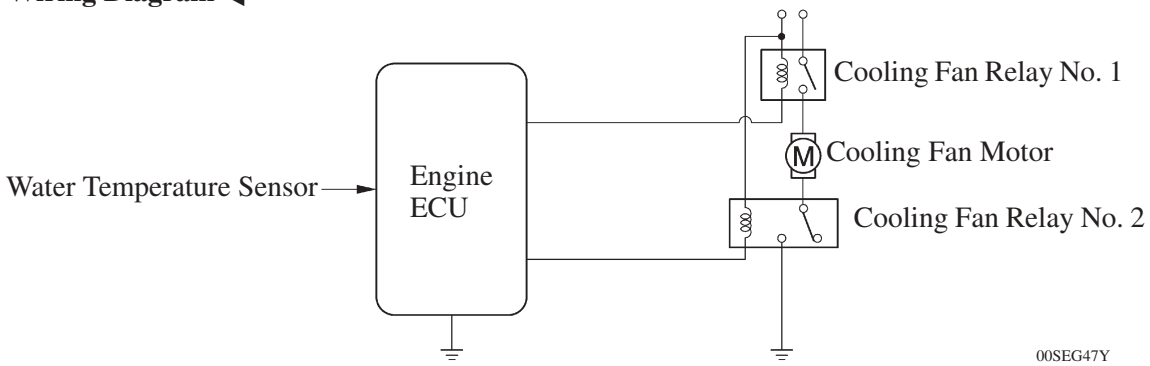
3) Hold

After reaching the target timing, the valve timing is held by keeping the camshaft timing oil control valve in the neutral position unless the traveling state changes.
This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.

8. Cooling Fan Control

- On the models without air conditioner, the engine ECU controls the operation of the cooling fan based on the water temperature sensor signal.

▶ Wiring Diagram ◀

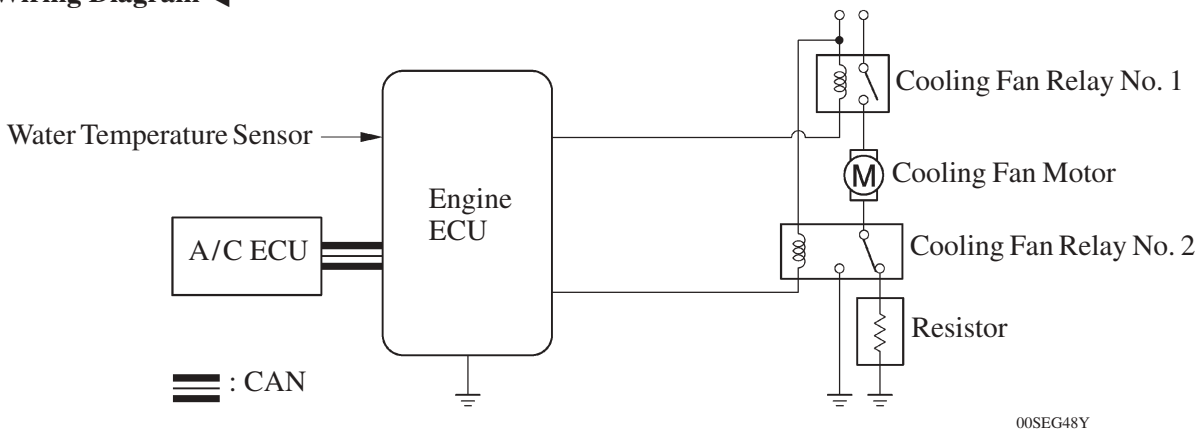


▶ Cooling Fan Operation ◀

Water Temperature*1	Low	High
Cooling Fan Operation	OFF	ON

- On the models with air conditioner, the engine ECU controls the operation of the cooling fan in two speeds (low and high) based on the water temperature sensor signal and the A/C ECU signal.
  The low speed operation is accomplished by applying the current through a resistor, which reduces the speed of the cooling fan.

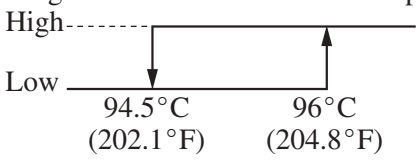
▶ Wiring Diagram ◀



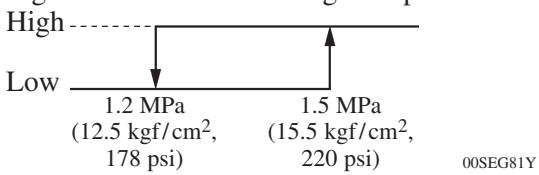
▶ Cooling Fan Operation ◀

Water Temperature*1	Air Conditioner Condition		Cooling Fan Operation
	A/C Switch	Refrigerant Pressure*2	
Low	OFF	Low	OFF
	ON	Low	Low
	ON	High	High
High	OFF	Low	High
	ON	Low	High
	ON	High	High

*1: Judgmental standard of water temperature



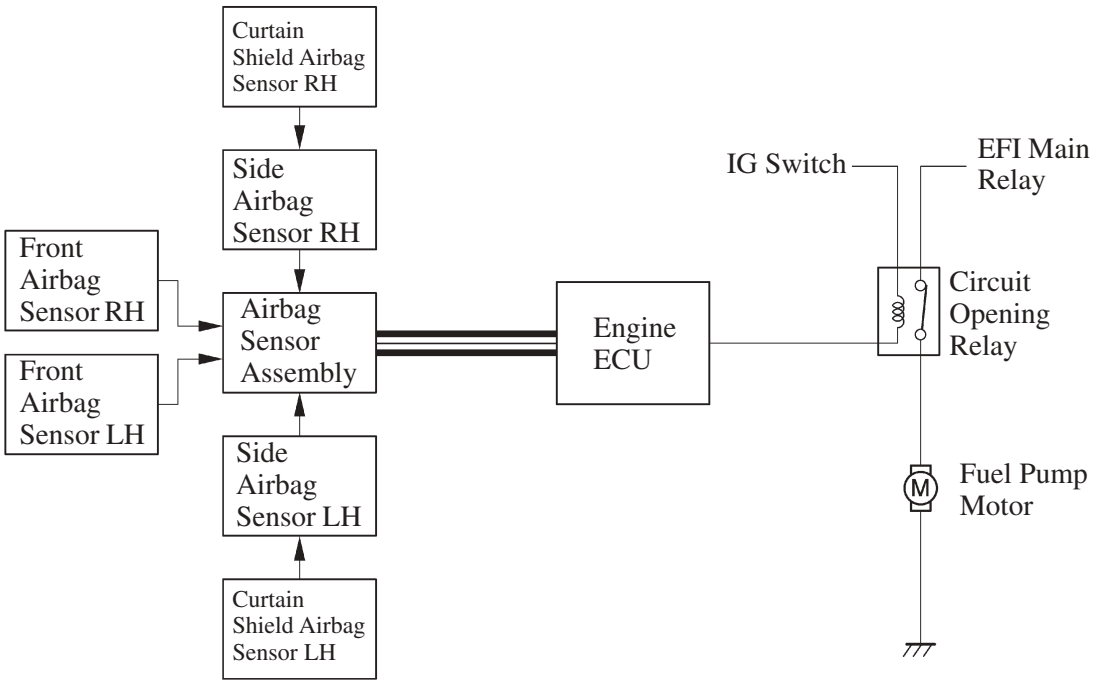
*2: Judgmental standard of refrigerant pressure



9. Fuel Pump Control

- A fuel cut control is used to stop the fuel pump once when the SRS airbags are deployed in a front or side collision.
- In this system, the airbag deployment signal from the airbag assembly is detected by the engine ECU, and it turns OFF the circuit opening relay. After the fuel cut control has been activated, turning the ignition switch from OFF to ON*1 or selecting the engine switch from OFF to IG-ON mode*2 cancels the fuel cut control, and the engine can be restarted.

*1: Models without Smart Entry & Start System
*2: Models with Smart Entry & Start System



: CAN

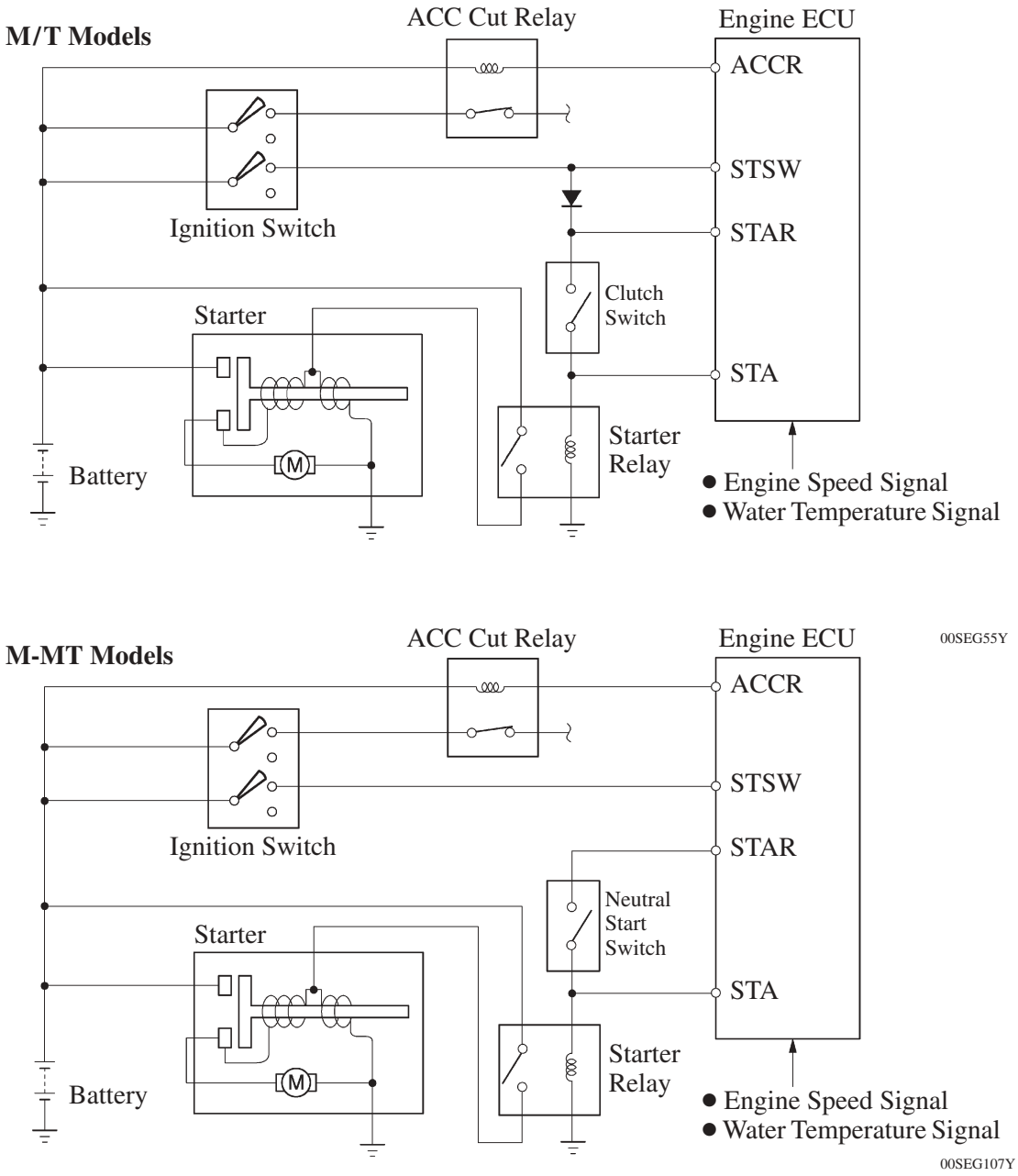
10. Cranking Hold Function

General

1) For Models without Smart Entry & Start System

- Once the ignition switch is turned to the START position, this control continues to operate the starter until the engine starts, without having to hold the ignition switch in the START position. This prevents starting failures.
- When the engine ECU detects a start signal from the ignition switch, this system monitors the engine speed (NE) signal and continues to operate the starter until it determines that the engine has started.
- On the M-MT models, even if the engine ECU detects a start signal from the ignition switch, it will not operate the starter if it has determined that the engine has already started.

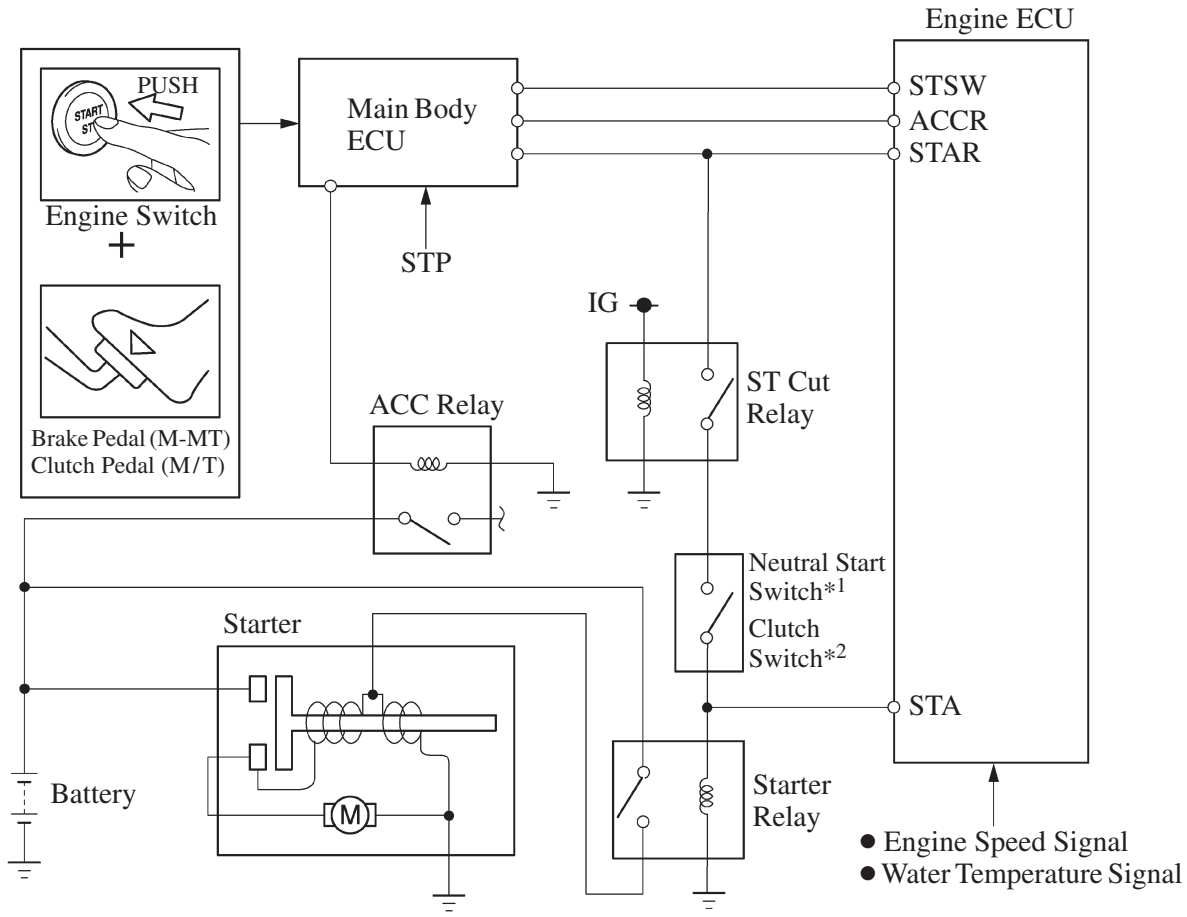
▶ System Diagram ◀



2) For Models with Smart Entry & Start System

- Once the engine switch is pushed, this function continues to operate the starter until the engine starts, provided that the brake pedal on the M-MT models or clutch pedal on the M/T models is pressed. This prevents starting failures and the engine from being cranked after the engine has started.
- When the engine ECU detects a start signal from the main body ECU, this system monitors the engine speed (NE) signal and continues to operate the starter until it determines that the engine has started. Furthermore, even if the engine ECU detects a start signal from the main body ECU, this system will not operate the starter if the engine ECU has determined that the engine has already started.

▶ System Diagram ◀



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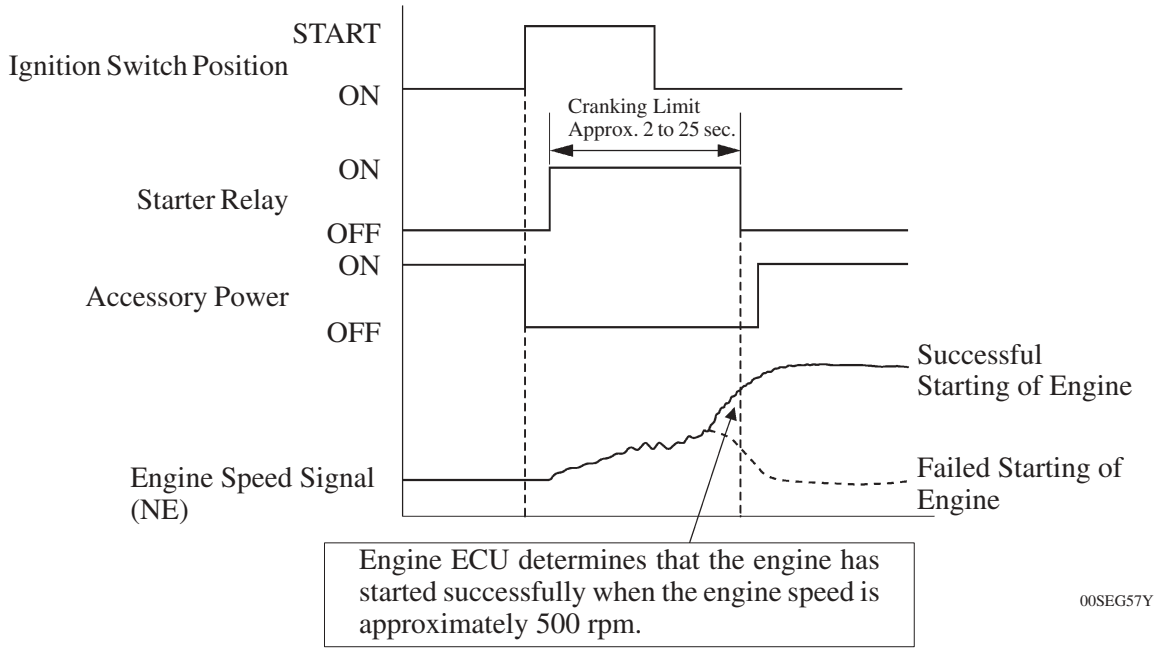
*1: M-MT Models
*2: M/T Models

Operation

1) For Models without Smart Entry & Start System

- As indicated in the following timing chart, when the engine ECU detects a start signal from the ignition switch, it energizes the starter relay to operate the starter. If the engine is already running, the engine ECU will not energize the starter relay.
- After the starter operates and the engine speed becomes higher than approximately 500 rpm, the engine ECU determines that the engine has started and stops the operation of the starter.
- If the engine has any failure and does not work, the starter operates as long as its maximum continuous operation time and stops automatically. The maximum continuous operation time is approximately 2 seconds through 25 seconds depending on the water temperature condition. When the water temperature is extremely low, it is approximately 25 seconds and when the engine is warmed up sufficiently, it is approximately 2 seconds.
- This system cuts off the current that powers the accessories while the engine is cranking to prevent the accessory illumination from operating intermittently due to the unstable voltage that is associated with the cranking of the engine.
- This system has the following protections.
  - On the M-MT models, while the engine is running normally, even if turning the ignition switch to START position, the starter will not operate.
  - On the M-MT models, in case that the driver keeps holding the ignition switch in START position and the engine successfully started, the engine ECU will stop the starter operation when the engine speed has become approximately 1,200 rpm or more.
  - On the M-MT models, in case that the driver keeps holding the ignition switch in START position and the engine will not start, the engine ECU will stop the starter operation when approximately 30 seconds have been passed.
  - In case that the starter begins to operate, but cannot detect the engine speed signal, the engine ECU will stop the starter operation immediately.

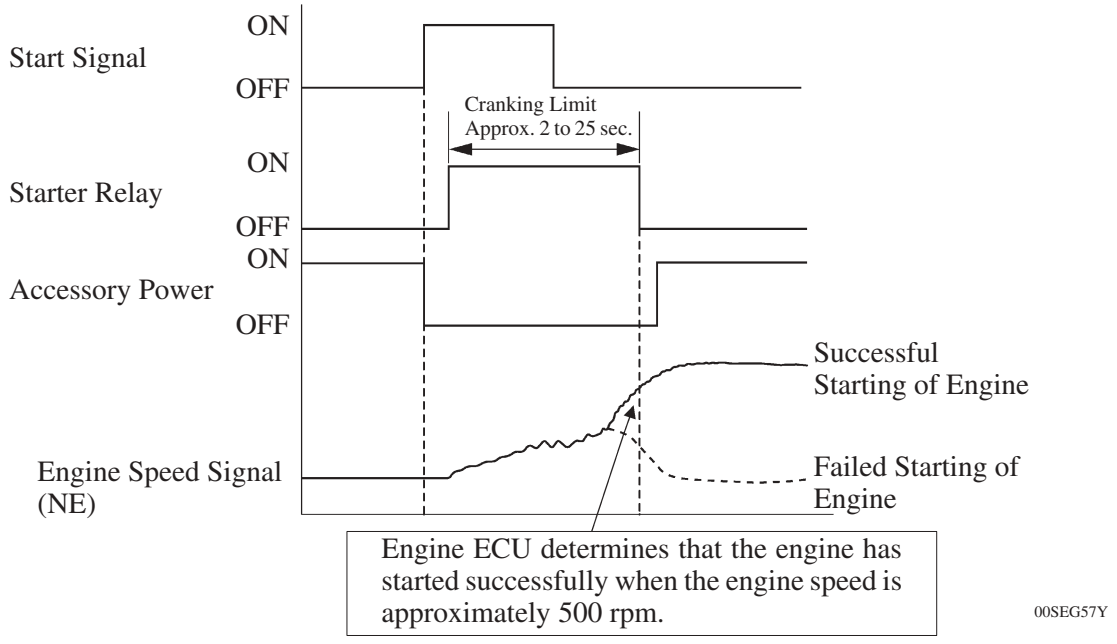
▶ Timing Chart ◀



2) For Models with Smart Entry & Start System

- As indicated in the following timing chart, when the engine ECU detects a start signal (STSW) from the main body ECU, the engine ECU outputs STAR and ACCR signals to the main body ECU. Upon detecting the STAR and ACCR signals from the engine ECU, the main body ECU energizes the starter relay to operate the starter. If the engine is already running, the engine ECU stops the output of the STAR and ACCR signals to the main body ECU. Thus, the main body ECU will not energize the starter relay.
- After the starter operates and the engine speed becomes higher than approximately 500 rpm, the engine ECU determines that the engine has started and stops the output of the STAR and ACCR signals to the main body ECU. Thus, the main body ECU will stop the operation of the starter.
- If the engine has any failure and does not work, the starter operates as long as its maximum continuous operation time and stops automatically. The maximum continuous operation time is approximately 2 seconds through 25 seconds depending on the water temperature condition. When the water temperature is extremely low, it is approximately 25 seconds and when the engine is warmed up sufficiently, it is approximately 2 seconds.
- This system cuts off the current that powers the accessories while the engine is cranking to prevent the accessory illumination from operating intermittently due to the unstable voltage that is associated with the cranking of the engine.
- This system has the following protections.
  - While the engine is running normally, the starter does not operate.
  - In case the driver keeps pressing the engine switch and the engine successfully started, the engine ECU stops the output of the STAR and ACCR signals when the engine speed becomes higher than 1,200 rpm. Thus, the main body ECU will stop the operation of the starter.
  - In case the driver keeps pressing the engine switch and the engine does not start, the engine ECU stops the output of the STAR and ACCR signals after 30 seconds have elapsed. Thus, the main body ECU will stop the operation of the starter.
  - In case the engine ECU cannot detect an engine speed signal while the starter is operating, the engine ECU will immediately stop the output of the STAR and ACCR signals. Thus, the main body ECU will stop the operation of the starter.

▶ Timing Chart ◀



11. Diagnosis

- The diagnosis system of the 1KR-FE engine uses the EURO-OBD (EURO On-Board Diagnosis).
- When the engine ECU detects a malfunction, the engine ECU makes a diagnosis and memorizes the failed section. Furthermore, the check engine warning light in the combination meter illuminates or blinks to inform the driver.
- By using the intelligent tester II, the 5-digit DTCs and ECU data can be read out. Moreover, the ACTIVE TEST can be used to drive the actuator by means of the intelligent tester II.
- The engine ECU can output freeze-frame data to the intelligent tester II. This data is stored in the engine ECU at the very moment when the engine ECU detects its last data of malfunction.
- All the DTCs have been made to correspond to the SAE controlled codes. Some of the DTCs have been further divided into smaller detection areas than in the past, and new DTCs have been assigned to them.
- For details, refer to the Yaris Repair Manual (Pub. No. RM00S1E).

Service Tip

To clear the DTC that is stored in the engine ECU, use the intelligent tester II, and disconnect the battery terminal or remove the EFI fuse for 1 minute or longer.

12. Fail-safe

When a malfunction is detected by any of the sensors, there is a possibility of an engine or other malfunction occurring if the engine ECU were to continue to control the engine control system in the normal way. To prevent such a problem, the fail-safe function of the engine ECU either relies on the data stored in memory to allow the engine control system to continue operating, or stops the engine if a hazard is anticipated. For details, refer to the Yaris Repair Manual (Pub. No. RM00S1E).